18. State and explain the conservation laws for a system of charges and electromagnetic fields.

19. Obtain the electric and magnetic field from an oscillating electric dipole and hence calculate the Poynting vector.

20. Derive the Fresnel's for the reflected and transmitted intensities for a plane electromagnetic wave is incident on a plane boundary between two non-conducting media.

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NOVEMBER/DECEMBER 2025

GPH22/DPH22 — ELECTROMAGNETIC THEORY

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Calculate the work done in moving a charge once round a closed path in an electric field.

2. Define electric susceptibility.

3. Write down the Biot-Savart's law for volume current density J (r').

4. Give an expression for magneto static energy.

5. Write down the Faraday's law of electromagnetic induction.

6. Mention any two characteristics of displacement current.

7. What is an oscillating dipole?

8. Define radiation resistance.

9. The constitution parameters of aluminum are given by and Find the frequency for which the skin depth of aluminum is 0.01mm.

10. What are TE and TM modes in a wave guide?

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) State and prove Gauss law in electrostatics.

Or

(b) Deduce an expression for the electric field intensity at a point inside a dielectric sphere placed in an uniform electric field.

12. (a) Using Biot-Savart law, Derive an expression for the magnetic induction at a distance from an infinitely long straight conductor carrying current.

Or

(b) What are magnetic scalar and vector potentials? Discuss their characteristics.

13. (a) State and prove Poynting's theorem.

Or

(b) Show that Coulomb gauge is a transverse gauge.

14. (a) Show that the radiation resistance due to a small current element is given by ohms.

Or

(b) Derive an expression for the resultant electric intensity due to an array.

15. (a) Show that when electromagnetic waves propagate in a conducting medium the magnetic vector lags behind electric vector.

Or

(b) Show that in a wave guide, TEM waves cannot be propagated along the axis.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Obtain the solution of Laplace equation in Cartesian and spherical coordinates.

17. Deduce Ampere's circuital law in differential form and integral form and hence obtain the expression for magnetic field inside and outside a long solenoid.